PENTAIR

KEYSTONE

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1. Introduction

The OM11 DeviceNet interface is an electronic module that allows you to connect the Keystone EPI$_2$ electrical actuator to a DeviceNet network. The module has its own microprocessor and acts as a pure bus interface without affecting the actuator control integrity. It is installed inside the actuator housing and takes the electrical power from the actuator power supply module. The DeviceNet network is fully isolated from the actuator electronics. For details about EPI$_2$ actuator the reference manual is: EPI$_2$ Quarter-turn Electric Actuator IOM.

Warning

EPI$_2$ actuators must be electrically isolated before any disassembling or reassembling operations. Before any disassembling or reassembling operations, please follow in detail the relevant paragraph of the basic installation and operating manual (latest revision available).

Warning

The electronic parts of the EPI$_2$ actuators and all option modules can be damaged by a discharge of static electricity. Before you start, touch a grounded metal surface to discharge any static electricity.

Warning

It is assumed that the installation, configuration, commissioning, maintenance and repair works are carried out by qualified personnel and checked by responsible specialists.

Warning

Repair work, other than operations outlined in this manual, is strictly reserved to qualified Pentair personnel or to personnel authorized by the company itself.

2. Operation and storage

The module is designed to work and to be stored in the same environment of the actuator.

3. Communication features

Communication protocol	CAN bus standard, 5 wires DeviceNet application
Network topology	Line / Trunk-drop topology
Transmission medium	Specific cable for DeviceNet network: 1 twisted pair for power, 1 twisted pair for data and shield
Data rate	125 250 500 Kbps
Cable length	500 250 100 m (length may vary also with cable thickness)
Device number	64 devices per segment
Bus access	Producer-consumer network
Bus termination	External bus terminators required

Keystone implementation

Device type	Generic (00hex)
Group	Group 2 only slave
Physical layer	Isolated node with transceiver powered by the network
Current consumption	Current drawn from the network to power the transceiver: 29 mA at 24 V; 27 mA at 17 V; 25 mA at 11 V
Communication	Predefined master/slave connection: explicit message and polled I/O
Baud rate	125 Kbps, 250 Kbps, 500 Kbps (default 125 Kbps). Network configurable or manual configurable via on-board rotary BCD switch
Addressing (MACID)	0-63 (default 63). Network configurable or manual configurable via on-board rotary BCD switches
Temperature	-40°C, +85°C
EMC protections	EN 50081-2 and EN 50082-2

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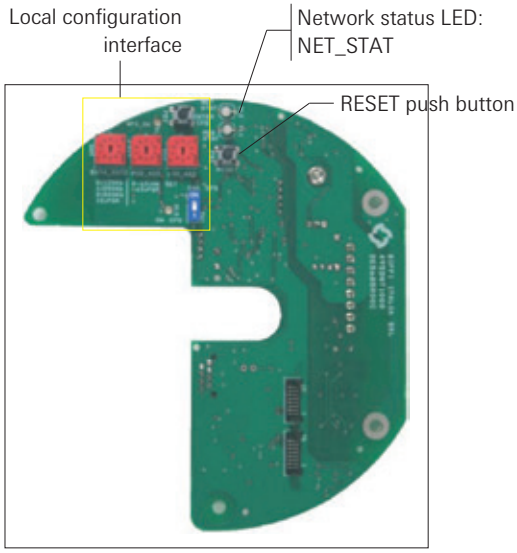
4. DeviceNet interface module

The module consists in a single PCB that is installed inside the actuator housing. It is connected to the EPI$_2$ base card via flat cable. The internal wiring connects the DeviceNet data lines to the actuator terminal board.



4.1 On-board indication module

The DeviceNet interface is equipped with 5 LEDs, pushbuttons and BCD rotary switches to offer a configuration and diagnostic interface on-board.

MOD_STAT

Module Status LED as defined in spec. Vol. 3 'DeviceNet Adaptation for CIP', chapter 9.

Condition	LED	Description
No power	Off	There is no power applied to the device
Operational	Green	The device is operating in a normal condition
Standby	Flashing green	The factory commissioning is not finished: serial number not yet assigned
Minor fault	Flashing red	Recoverable fault due to a non critical diagnostic indication
Unrecoverable fault	Red	Device has an unrecoverable fault: - HW alarm - Power failure alarm - Position sensor alarm - High temperature alarm

NET_STAT

Network Status LED as defined in spec. Vol. 3 'DeviceNet Adaptation for CIP', chapter 9.

Condition	LED	Description
Not powered/not on-line	Off	Device is not on-line
On-line, not connected	Flashing green	Device is on-line, but is not allocate to a Master
Link OK on-line connected	Green	Device is on-line and is not allocate to a Master
Connection time-out	Flashing red	One ore more I/O connection are in timed-out state
Critical link failure	Red	Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network (Duplicate MACID or Bus-Off)
Communication faulted and received anidentify comm fault request – long protocol	Flashing red & green	A specific Communication Faulted device The device has detected a Network Access error and is in the Communication Faulted state. The device has subsequently received and accepted an Identify Communication Faulted Request-Long Protocol message

RESET

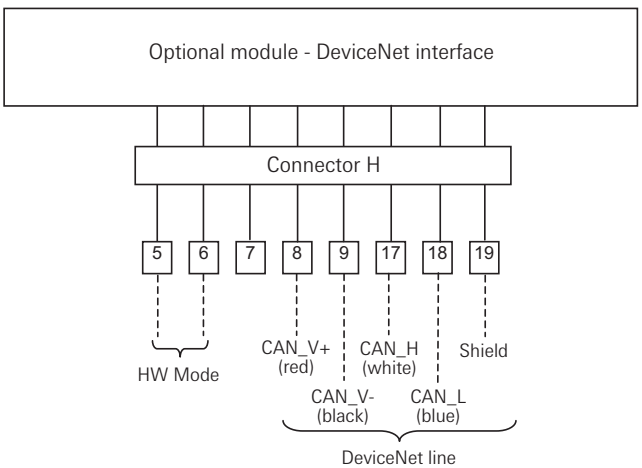
Reset pushbutton

Local configuration

On-board interface for local configuration of MACID and Baud Rate. By default the board is set to accept MACID and Baud Rate from the network, but it is also possible to set these parameters by hardware setting. Detailed procedures are given in chapter 7: 'Local configuration'

4.2 Wiring diagram

The Devicenet interface is connected to the actuator terminal board by internal wiring as shown below:



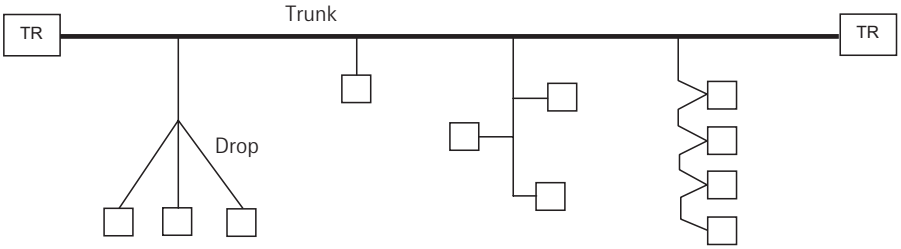
4.3 Bus/hardwired mode selection

The DeviceNet interface manages the bus/hardwired mode selection by means of the input terminal indicated with HW MODE. The physical input accepts from 24 to 125 V DC or AC, polarity insensitive. When the input is left unconnected or no voltage is applied, the actuator is under bus control from which is possible to send commands and read status.
When an appropriate voltage is applied to the HW MODE input, the actuator turns under Hardwired control. In this condition the bus can only read actuator status while the actuator follows the hardwired open and close controls connected to the terminal board. For further details see the relevant wiring diagram and the user's manual: EPI$_2$ Quarter-turn Electric Actuator IOM.

5. Brief DeviceNet description

DeviceNet is a low-level network that provides connection between industrial field devices (sensors and actuators) and higher-level devices (controllers). DeviceNet uses CAN (Controller Area Network) for its datalink layer, and CIP (Common Industrial Protocol) for the upper layers of the network. The major physical and media characteristics of the DeviceNet are:

- Trunk-line / drop-line topology of the network;



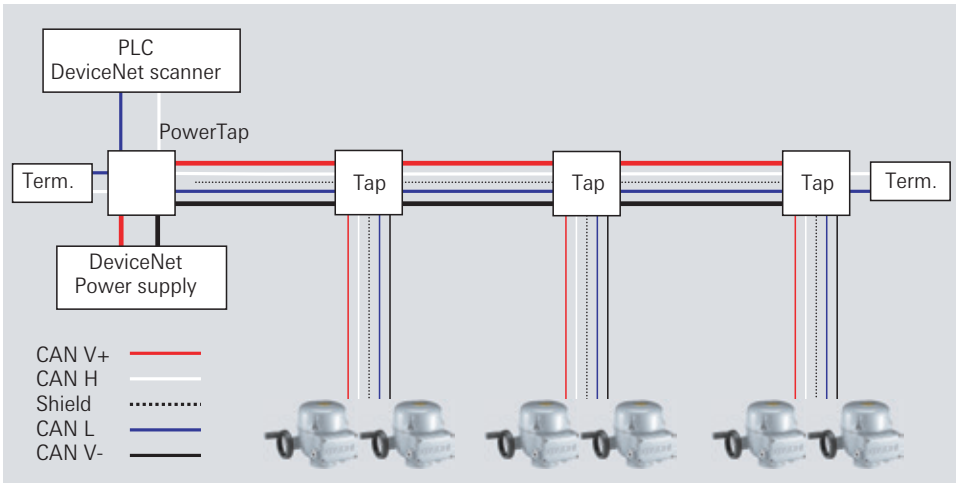
- Support for up to 64 devices in a network (i.e. 1 master and 63 EPI$_2$ actuators);
- Node removal without altering the network behavior;
- Support of both network-powered and self-powered devices on the same network;
- Wiring error protection;
- Selectable data rate of 125 k baud, 250 k baud and 500 k baud.

		Drop length	
Data rate	**Trunk distance**	**Maximum**	**Cumulative**
125 k baud	500 meters	6 meters	156 meters
250 k baud	250 meters	6 meters	78 meters
500 k baud	100 meters	6 meters	39 meters

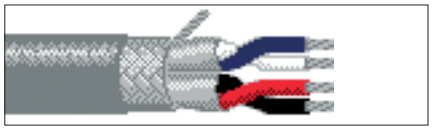
- Adjustable power configuration to meet individual application needs;
- High current capability (up to 8 A at 24 V DC);
- Operation with off-the-shelf power supplies;
- Available power taps that allow the connection of several power suppliers;
- Build-in overload protection;
- Controller Area Network (CAN) technology for Media Access Control and Physical Signalling.

5.1 Network cable

To obtain the expected performances from the communication network the suitable cable must be utilized. DeviceNet requires a specific cable composed of a Power pair, a Data Pair and a shield with drain wire. DeviceNet defines different cables to be used in the different parts of the network:



- in the trunk line is normally used the thick cable.
  E.g. BELDEN 3082A:
  1 pair 15 AWG 19x28 Tinned Copper – Power pair
  1 pair 18 AWG 19x30 Tinned Copper – Data pair inner shield 100% coverage
- in the drop line is normally used the thick cable. e.g. BELDEN 3084A
  E.g. BELDEN 3084A:
  1 pair 22 AWG 19x34 Tinned Copper – Power pair
  1 pair 24 AWG 19x36 Tinned Copper – Data pair inner shield 100% coverage



5.2 Terminator

The DeviceNet network must be terminated to each end of the main trunk line with a 120 ohm resistor across CAN_H and CAN_L data line.

6. Communication interface

The following paragraph describes the input and output data available at the DeviceNet interface. In all cases a parameter is called 'input signal' when data is sent from actuator to bus, vice-versa it is called 'output signal' when data is sent from bus to slave.

6.1 Actuator commands

The commands are received from the DeviceNet network and are forwarded to the base card via the internal data bus.

Output Assembly Instance: Class 4; Instance 101; Attribute 3

Byte	b7	b6	b5	b4	b3	b2	b1	b0
0	Reserved	Reserved	Reserved	Reserved	Positioner Enable	Stop Command	Close Command	Open Command
1	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved
2	LSB Set point							
3	MSB Set point							

Indication	Description	Data Type	Range	E.U.
Open Command	When this bit is set to 1 an Open Command is issued to the actuator. The open command is maintained during the whole movement from the start of the bus command until the Open Limit has been reached. The open command is reset when a STOP Command is received from the bus.	Boolean	0-1	-
Close Command	When this bit is set to 1 a Close Command is issued to the actuator. The close command is maintained during the whole movement from the start of the bus command until the Close Limit has been reached. The close command is reset when a Stop Command is received from the bus.	Boolean	0-1	-
Stop Command	When this bit is set to 1 a Stop Command is issued to the actuator. A Stop Command received from the bus resets both open and close commands.	Boolean	0-1	-
Positioner Enable	When this bit is set to 1 the on-board positioner is enabled. The positioner is enabled until this bit is set to 0.	Boolean	0-1	-
Set point	The Setpoint received from the bus is used to produce the open or close commands to the actuator as defined in paragraph 6.2.1: 'Positioning algorithm'.	Integer	0-1000	0.1%

6.2 Actuator status and indication

The status is received from the base card via the internal data bus and is reported to the DeviceNet network.

Input Assembly Instance: Class 4; Instance 100; Attribute 3

Byte	b7	b6	b5	b4	b3	b2	b1	b0
0	Positioner active	Intermediate position	Motor stopped	Fully close	Actuator moving	Closing	Opening	Fully open
1	Monitor Relay	Reserved	PDA Active	HW Mode Active	LOCAL selected	General ALARM	Not Oper Close	Not Oper Open
2	HW alarm	Mid travel alarm	Motor dir. alarm	Opt. loc. cnt. alarm	Strk. limit alarm	Torque CL alarm	Torque OP alarm	Pwr fail alarm
3	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	High temp alarm	Pos. Sen. alarm
4	LSB Current Position							
5	MSB Current Position							
6	Current Torque							
7	Current Temperature							

Indication	Description	Data Type	Range	E.U.
Fully Open	The Fully Open indication is set to 1 when the actuator is at Fully Open position. This indication reflects the status of the open limit on the actuator.	Boolean	0-1	-
Opening	The Opening indication is set to 1 when the actuator is moving toward opening direction.	Boolean	0-1	-
Closing	The Closing indication is set to 1 when the actuator is moving toward closing direction.	Boolean	0-1	-
Actuator Moving	This indication is set to 1 when the actuator is moving either in opening or in closing direction.	Boolean	0-1	-
Fully Close	The Fully Close indication is set to 1 when the actuator is at Fully Close position. This indication reflects the status of the close limit on the actuator.	Boolean	0-1	-
Motor Stopped	This indication is set to 1 when the actuator is not moving and the motor has stopped.	Boolean	0-1	-
Intermediate position	This indication is set to 1 when the valve is at an intermediate position.	Boolean	0-1	-
Positioner active	This indication is set to 1 when the on-board positioner is enabled.	Boolean	0-1	-
Alarm in Open Direction	Open command not available due to current alarm trip in open direction. The diagnostic indication is cleared when the alarm that has generated the fault disappears.	Boolean	0-1	-
Alarm in Close Direction	Close command not available due to current alarm trip in close direction. The diagnostic indication is cleared when the alarm that has generated the fault disappears.	Boolean	0-1	-
General Alarm	Bus can only read data due to alarm present. The diagnostic indication is cleared when all the alarm conditions are cleared.	Boolean	0-1	-
LOCAL selected	No operation from bus because LOCAL selector switch is activated. The diagnostic indication is cleared when the selector is turned to REMOTE.	Boolean	0-1	-
HardWired Mode selected	No operation from bus because HARDWIRED mode is activated. The diagnostic indication is cleared when the input HW MODE is not powered.	Boolean	0-1	-
PDA Active	No operation from bus because PDA operator interface has the control (only if Bluetooth option is available). The diagnostic indication is cleared when the PDA control is released.	Boolean	0-1	-
Monitor Relay	This indication is set to 1 when the actuator is available for bus control. Monitor Relay indication means that the local selector is at Remote position, no other remote interfaces have the control (Hardwired or PDA) and no alarms are present.	Boolean	0-1	-
Power failure alarm	This bit is set when the main power supply is not in the proper range. The diagnostic indication is cleared at the next power up if the power supply is corrected.	Boolean	0-1	-
Torque alarm in opening	This bit is set when the Torque has reached the programmed limit while the actuator was moving in opening direction. The diagnostic indication is cleared by a Close command	Boolean	0-1	-
Torque alarm in closing	This bit is set when the Torque has reached the programmed limit while the actuator was moving in closing direction. The diagnostic indication is cleared by an Open command.	Boolean	0-1	-
Stroke limit alarm	This bit is set when the current position is behind the Open or Close limit switches or as result of an incorrect Torque Set. The diagnostic indication is cleared when the position returns within the limits or after a successful Torque Set procedure	Boolean	0-1	-
Local control alarm	This bit is set when the optional Local Control Module does not work correctly. The diagnostic indication is cleared when the Local Control works without problems.	Boolean	0-1	-
Motor direction alarm	This bit is set when the motor drive has recognised an incorrect behaviour. The diagnostic indication is cleared by a command in the opposite direction.	Boolean	0-1	-
Jammed valve	This bit is set when the actuator detects a jammed valve condition. The diagnostic indication is cleared by any new command.	Boolean	0-1	-
HW alarm	This bit is set when the actuator detects a general hardware error. The diagnostic indication is cleared at the next power up under normal condition.	Boolean	0-1	-
Position sensor alarm	This bit is set when the actuator detects that position sensor is not working properly.	Boolean	0-1	-
High temperature alarm	This bit is set when the internal temperature is out of the operational limits. The diagnostic indication is cleared when the internal is within the limits.	Boolean	0-1	-
Current position	The current position read from base card	Integer	0-1000	0,1%
Current torque	The current torque read from base card	Integer	0-100	%
Internal temperature	The current internal temperature	Integer	-45 +85	°C

6.2.1 Positioning algorithm

A positioning algorithm (position closed loop control) is implemented on the DeviceNet interface module.

The positioning function consists of comparing the position, received from the base card, with the position request received from bus. If the difference between 'position request and present position' is greater than 'Dead Band' an Open or a Close command is send to base card. The dead Band is configurable via bus from 0.3 to 2.0%.

6.3 Fail Safe data

The Fail Safe data parameter defines the behavior of the actuator in case of network communication failure. The Fail Safe data parameter can be modified via DeviceNet network.

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 1: Class 100; Instance 1; Attribute 100						
Safety action	The action to execute in case of loss of bus communication. 0= No action 1= Stop 2= Close 3= Open 4= Go to predefined position	R/W	Integer	0-4	0	-
Parameter 2: Class 100; Instance 1; Attribute 101						
Predef. safety position	Safe predefined position	R/W	Integer	0-100	50	%
Parameter 3: Class 100; Instance 1; Attribute 102						
Delay on bus fail	Delay before to initiate the Safety Action	R/W	Integer	0-10	4	sec

6.4 Dead Band configuration

The Dead Band indicates the maximum allowed deviation from the valve position and the requested position. If the deviation is bigger, an open or close control command will be generated.

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 4: Class 100; Instance 1; Attribute 103						
Dead Band	This parameter defines the Dead Band of the positioning function available on the modulating actuator (in tenth of %). The movement is inhibited until the difference between current position and requested position (position error) is lower than Dead Band.	R/W	Integer	3- 20	15	0.1%

6.5 User defined data

The User defined data is stored in the EPI$_2$ actuator and is available on the DeviceNet network for Asset Management information.

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 5: Class 100; Instance 1; Attribute 104						
Actuator serial number	Actuator serial number	Only read	Short string	12 bytes	-	-
Parameter 6: Class 100; Instance 1; Attribute 105						
Actuator type	Actuator type	Only read	Short string	12 bytes	-	-
Parameter 7: Class 100; Instance 1; Attribute 106						
Valve tag	Valve tag	Only read	Short string	12 bytes	-	-

6.6 Configuration data

The Configuration data is received from the base card via the internal data bus and is reported to the DeviceNet network. The Configuration data can also be modified via the DeviceNet network and the interface will send the new values to the logic board.

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 8: Class 100; Instance 1; Attribute 112						
Close direction	The direction the actuator drives the motor when it receives a Close command. 0= Clockwise (CW) 1= Clockwise (CCW)	R/W	Integer	0-1	1	-
Parameter 9: Class 100; Instance 1; Attribute 113						
Opening speed set	It defines the speed of the motor when opening.	R/W	Integer	0-9	7	-
Parameter 10: Class 100; Instance 1; Attribute 114						
Closing speed set	It defines the speed of the motor when closing.	R/W	Integer	0-9	7	-
Parameter 11: Class 100; Instance 1; Attribute 115						
Opening torque set	Opening torque.	R/W	Integer	0-9	7	-
Parameter 12: Class 100; Instance 1; Attribute 116						
Closing torque set	Closing torque.	R/W	Integer	0-9	7	-

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 13: Class 100; Instance 1; Attribute 117						
Open limit	It defines the end of travel setting in Open direction: 0= open limit by torque 1= open limit by position	R/W	Integer	0-1	1	-
Parameter 14: Class 100; Instance 1; Attribute 118						
Close limit	It defines the end of travel setting in Close direction: 0= close limit by torque 1= close limit by position	R/W	Integer	0-1	1	-
Parameter 15: Class 100; Instance 1; Attribute 119						
Nominal torque	Nominal torque of the motor: 0= 63 Nm 1= 125 Nm 2= 250 Nm 3= 500 Nm 4= 1000 Nm 5= 2000 Nm	Only read	Integer	0-5	-	-
Parameter 16: Class 100; Instance 1; Attribute 120						
LED colour code	It defines the colour of the LED indicating the Fully Open and Fully Close position: 0: Open: LED=green; Close: LED=red 1: Open: LED= red; Close: LED= green	R/W	Integer	0-1	0	-

6.7 DeviceNet configurable parameters

For correct communication and identification of the actuator it is required to configure the correct MACID and Baud Rate.

Indication	Description	Direction	Data Type	Range	Default	E.U.
Parameter 17: Class 3; Instance 1; Attribute 1						
MACID	The MACID to assign to the device	R/W	Unsigned	0-63	63	-
Parameter 18: Class 3; Instance 1; Attribute 2						
Baud Rate	The Baud Rate to assign to the device	R/W	Unsigned	0-2	0	-

6.8 EDS file

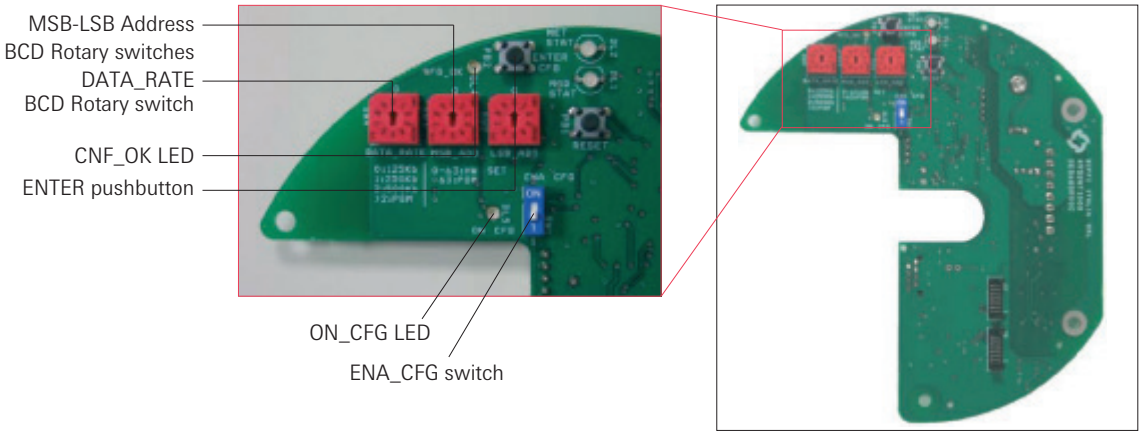
The DeviceNet interface module is provided with an Electronic Data Sheet (EDS) file. The EDS file is DeviceNet specific and provides information about the device configuration data. The EDS file is used by the DeviceNet configuration tool in order to get all the information necessary to the device configuration and to the access and alter the configurable parameters of the EPI$_2$ actuator.

7. Local settings

The DeviceNet interface module is equipped with 3 on-board selector switches to allow the operator configuration of both the MACID and the Baud Rate of DeviceNet communication.
To access the on-board interface on the DeviceNet interface module it is necessary to follow the procedures explained in 'EPI$_2$ Quarter-turn Electric Actuator IOM' at Chapter 6: 'Actuator settings and configuration' and then follow the procedures described in the next paragraphs.

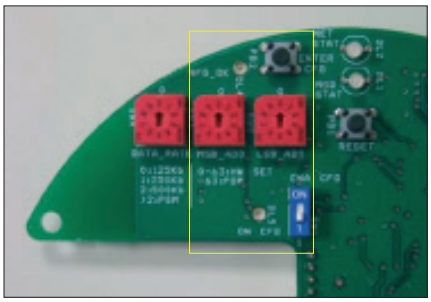
7.1 On-boards interface

The on-board interface is equipped with the following switches and indications.



7.2 DeviceNet MACID configuration

The DeviceNet interface module allows MACID setting both for manual configuration as for software configuration by means of two ten-position BCD rotary switches as indicated in the figure.
The current setting is read in decimal representation:
MSB_ADD specifies the ten (1x, 2x, 3x, …); LSB_ADD specifies the unit (x1, x2, x3, …).



MACID configuration

Manual configuration

When BCD rotary switches specify a valid DeviceNet MACID, i.e. a value from 00 to 63, the module considers this value as the device MACID.

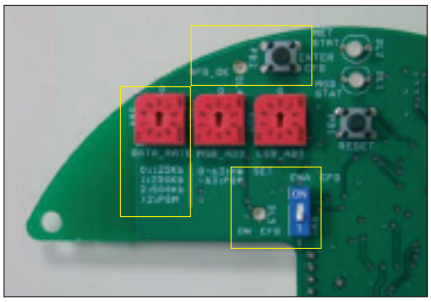
Software configuration

If the switches specify an invalid DeviceNet MACID, i.e. a value greater than 63, the module uses the value stored in non-volatile memory and is ready for software configuration of MACID via specific communication message.

Configuration procedure

To change the current value of the BCD rotary switches to set a different MACID, the user shall follow this procedure:

- Move the dip switch ENA_CFG to the ON position: the ON_CFG LED is activated to indicate that the actuator has entered Configuration Mode
- Set the new MACID via the rotary switches MSB_ADD and LSB_ADD.
  E.g.: to set MACID = 28:
  MSB_ADD. on position 2
  LSB_ADD on position 8
- Press the pushbutton ENTER to confirm the new set: if the new MACID is correct the CFG_OK LED turns ON
- Move the dip switch ENA_CFG on the OFF position to exit from Configuration Mode: the DeviceNet interface module is reset to activate the new configuration.



Communication speed configuration

7.3 DeviceNet communication speed configuration

The DeviceNet interface module allows also Date Rate setting via manual configuration (or software configuration) by means of one ten-position BCD rotary switch DATA_RATE as indicated in the figure.

Manual configuration

When BCD rotary switch specify one of the following valid DeviceNet Data Rate:
0: 125 Kbps
1: 250 Kbps
2: 500 Kbps
the module will work at the selected data rate.

Software configuration

If the switches specify any other invalid DeviceNet Data Rate, i.e. a value from 4 to 9, the module uses the value stored in non-volatile memory and is ready for software configuration of Data Rate via a specific communication message.

Configuration procedure

To change the current value of the BCD rotary switch to set a different Data Rate, the user shall follow this procedure:

- Move the dip switch ENA_CFG on the ON position: the ON_CFG LED turns ON to indicate that the actuator is entered in Configuration Mode
- Set the new Data Rate on the rotary switches DATA_.
- Press the pushbutton ENTER to confirm the new set: if the new MACID is correct the CFG_OK LED turns ON
- Move the dip switch ENA_CFG on the OFF position to exit from Configuration Mode: the DeviceNet interface module is reset to activate the new setting.

8. Bluetooth communication module

The OM11 module is provided with integrated Bluetooth module. In www.biffi.it you can download A-Manager program to modify each settings by integrated Bluetooth module. After installation of A-Manager program, please clic on ‘Operations’button and then clic on ‘Bluetooth Control’button and tick ‘on’.
The features and functionalities performed with Bluetooth module are indicated in A-Manager IOM for PDA (BIFCS-0029) and PC (BIFCS-0028).

9. DeviceNet certificate

EPI$_2$ actuators family equipped with DeviceNet interface module have passed the DeviceNet Conformance Test and can be declared.

DeviceNet CONFORMANCE TESTED™

Copy of the DeviceNet certificate can be viewed at ODVA website: www.odva.org